A WATERWAYS WITHIN THE SACRAMENTO-SAN JOAQUIN DELTA

Figure A.1 describes all named waterways within the statutory Delta boundary. Table A.1 lists by *code* the waterway names and codes shown on Figure A.1. Table A.2 lists by *name* the waterway names and codes shown on Figure A.1.

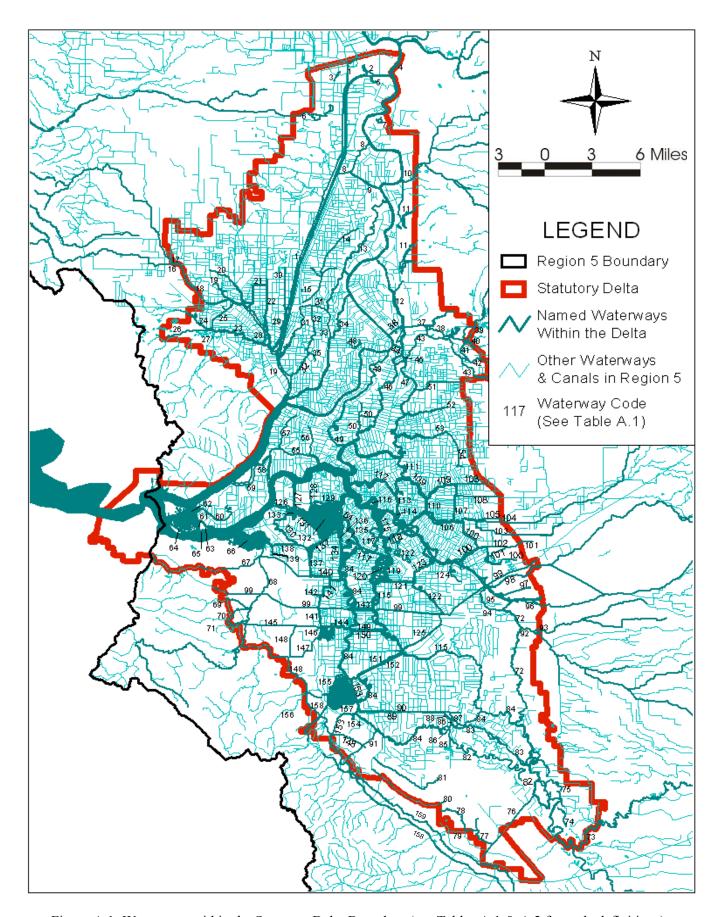


Figure A.1: Waterways within the Statutory Delta Boundary (see Tables A.1 & A.2 for code definitions)

Table A.1: Waterways within the Statutory Delta Boundary – by Code

- Toe Drain 2.
- Sacramento River Deep Water Channel
- 3. Greens Lake 4. Sacramento River
- 5. Lake Washington
- 6. South Fork Putah Creek
- Lake Greenhaven 7.
- Babel Slough
- Winchester Lake
- 10. Morrison Creek
- 11. Stone Lake
- 12. Snodgrass Slough
- 13. Elk Slough
- 14. Duck Slough
- 15. Medore Lake
- 16. Sweany Creek
- 17. Alamo Creek
- 18. Ulatis Creek
- 19. Cache Slough
- 20. Hass Slough
- 21. Lookout Slough
- 22. Shag Slough
 23. Lindsey Slough
 24. Barker Slough
 25. Hastings Cut

- 26. Calhoun Cut
- 27. The Big Ditch28. Wright Cut
- 29. Prospect Slough
- 30. Liberty Cut
- 31. Miner Slough
- 32. Elkhorn Slough
- 33. Sutter Slough
- 34. Steamboat Slough 35. Taylor Slough (Elkhorn
- Slough tributary)
- 36. The Meadows Slough
- 37. Lost Slough
- 38. Middle Slough
- 39. Cosumnes River
- 40. Bear Slough
- 41. Grizzly Slough
- 42. Dry Creek (Mokelumne River tributary)
- 43. Mokelumne River
- 44. Delta Cross Channel
- 45. Dead Horse Cut
- 46. North Fork Mokelumne
 - River
- 47. South Fork Mokelumne River
- 48. Beaver Lake
- 49. Georgiana Slough50. Broad Slough51. Beaver Slough

- 52. Hog Slough53. Sycamore Slough
- 54. Upland Canal Sevenmile Slough
- 55.
- Jackson Slough

- Tomato Slough 57.
- Threemile Slough 58.
- 59. Horseshoe Bend
- 60. Mayberry Slough
- 61. Mayberry Cut Sherman Lake 62.
- 63. Donlon Island
- Cabin Slough 64.
- 65. Gallagher Slough
- Big Break 66.
- Contra Costa Canal 67.
- Marsh Creek 68.
- 69. Sand Creek
- 70. Deer Creek
- Dry Creek (Marsh Creek 71 tributary)
- 72. San Joaquin River
- Stanislaus River 73.
- Red Bridge Slough 74.
- 75. Walthall Slough
- 76.
- Banta Carbona Lift Canal Lateral 4 West
- Lateral 5 West
- 79. Corral Hollow Creek
- 80. **Upper Main Canal**
- 81. Lower Main Canal
- Tom Paine Slough 82.
- Paradise Cut 83.
- Old River 84.
- 85. Sugar Slough
- 86. Crocker Cut
- Salmon Slough 87. **Doughty Cut** 88.
- Fabian and Bell Canal 89.
- 90 **Grant Line Canal**
- Mountain House Creek 91.
- 92. French Camp Slough
- Walker Slough 93.
- 94 Burns Cutoff
- 95. Stockton Deep Water
 - Channel
- 96. Mormon Slough
- 97. Smith Canal
- 98. Calaveras River Mokelumne Aqueduct 99.
- 100. Fourteen Mile Slough
- 101. Five Mile Creek
- 102. Five Mile Slough 103. Mosher Slough
- 104. Bear Creek 105. Pixley Slough
- 106. Disappointment Slough
- 107. Bishop Cut
- 108. Telephone Cut
- 109. White Slough
- 110. Honker Cut
- 111. Little Potato Slough
- 112. Potato Slough
- 113. Little Connection Slough 114. Little Venice Island
- 115. Middle River

- 116. Singapore Cut
- 117. Connection Slough
- 118. Columbia Cut
- 119. Latham Slough
- 120. Mildred Island
- 121. Empire Cut
- 122. Whiskey Slough
- 123. Turner Cut
- 124. Black Slough
- 125. Trapper Slough
- 126. False River
- 127. Fishermans Cut
- 128. Short Slough
- 129. Washington Cut 130. Taylor Slough (near Franks
 - Tract)
- 131. Piper Slough
- 132. Franks Tract 133. Little Franks Tract
- 134. Holland Cut
- 135. Little Mandeville Cut
- 136. Sheep Slough
- 137. Sand Mound Slough
- 138. Dutch Slough
- 139. Emerson Slough
- 140. Rock Slough
- 141. Werner Dredger Cut
- 142. Dead Dog Slough
- 143. Unnamed Canal(s) Between Bacon &
- Woodward Islands
- 144. Indian Slough 145. Main Canal
- 146. Discovery Bay
- 147. Kellog Creek
- 148. 45 Canal
- 149. Woodward Canal
- 150. North Victoria Canal
- 151. Victoria Canal
- 152. North Canal
- 153. West Canal
- 154. Livermore Yacht Club
- 155. Italian Slough 156. Brushy Creek
- 157. Clifton Court Forebay
- 158. California Aqueduct 159. Delta Mendota Canal

Table A.2: Waterways within the Statutory Delta Boundary – by Na	Table A.2:	avs within the Statuto	v Delta Boundar	v – bv Nam
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<u>Tab</u>	le A.2: Waterways wit
	45 Canal
17.	Alamo Creek
8.	Babel Slough
76.	Banta Carbona Lift Canal
24.	Barker Slough
104.	Bear Creek
40.	Bear Slough
48.	Beaver Lake
51.	Beaver Slough
66.	Big Break
	Bishop Cut
	Black Slough
50.	Broad Slough
156.	,
94.	Burns Cutoff
64.	Cabin Slough
19.	Cache Slough
98.	Calaveras River
26.	Calhoun Cut
	California Aqueduct
	Clifton Court Forebay
-	Columbia Cut
117.	
67.	Contra Costa Canal
79.	Corral Hollow Creek
39.	Cosumnes River
86.	Crocker Cut
142.	
45. 70	Dead Horse Cut
70.	Deer Creek
44.	Delta Cross Channel Delta Mendota Canal
159. 106.	
100.	11

- 106. Disappointment Slough
 146. Discovery Bay
 63. Donlon Island
 88. Doughty Cut
 71. Dry Creek (Marsh Creek tributary)
 42. Dry Creek (Mokelumne
- River tributary)
 14. Duck Slough
 138. Dutch Slough
 13. Elk Slough
 32. Elkhorn Slough
 139. Emerson Slough
 121. Empire Cut
 89. Fabian and Bell Canal
- 126. False River127. Fishermans Cut101. Five Mile Creek102. Five Mile Slough100. Fourteen Mile Slough132. Franks Tract
- 132. Franks Tract92. French Camp Slough65. Gallagher Slough49. Georgiana Slough90. Grant Line Canal

- Greens Lake Grizzly Slough 41. Hass Slough 20. 25. Hastings Cut Hog Slough 52. 134. Holland Cut 110. Honker Cut 59. Horseshoe Bend 144. Indian Slough 155. Italian Slough Jackson Slough 147. Kellog Creek 7. Lake Greenhaven Lake Washington 77. Lateral 4 West 78. Lateral 5 West 119. Latham Slough 30. Liberty Cut 23. Lindsey Slough 113. Little Connection Slough
- 113. Little Connection Slou
 133. Little Franks Tract
 135. Little Mandeville Cut
 111. Little Potato Slough
 114. Little Venice Island
 154. Livermore Yacht Club
 21. Lookout Slough
 37. Lost Slough
 81. Lower Main Canal
 145. Main Canal
 145. Marsh Creek
 61. Mayberry Cut
 60. Mayberry Slough

Medore Lake

115. Middle River

15.

- 38 Middle Slough 120. Mildred Island Miner Slough 31. Mokelumne Aqueduct 99. 43. Mokelumne River 96. Mormon Slough 10. Morrison Creek 103. Mosher Slough Mountain House Creek 91.
- 152. North Canal46. North Fork MokelumneRiver

150. North Victoria Canal

84. Old River
83. Paradise Cut
131. Piper Slough
105. Pixley Slough
112. Potato Slough
29. Prospect Slough
74. Red Bridge Slough
140. Rock Slough
4. Sacramento River

- 2. Sacramento River Deep Water Channel 87. Salmon Slough 72. San Joaquin River 69 Sand Creek 137. Sand Mound Slough Sevenmile Slough 55. Shag Slough 136. Sheep Slough Sherman Lake 128. Short Slough 116. Singapore Cut
- 128. Short Slough
 116. Singapore Cut
 97. Smith Canal
 12. Snodgrass Slough
 47. South Fork Mokelumne River
 6. South Fork Putah Creek
- 73. Stanislaus River
 34. Steamboat Slough
 95. Stockton Deep Water Channel
 11. Stone Lake
- Stone Lake
 Sugar Slough
 Sutter Slough
 Sweany Creek
 Sycamore Slough
 Taylor Slough (Elkhorn Slough tributary)
- 130. Taylor Slough (near Franks Tract)108. Telephone Cut
- 108. Telephone Cut27. The Big Ditch36. The Meadows Slough58. Threemile Slough
- Toe Drain
 Tom Paine Slough
- 57. Tomato Slough125. Trapper Slough123. Turner Cut18. Ulatis Creek
- 143. Unnamed Canal(s)
 Between Bacon &
 Woodward Islands54. Upland Canal
- 54. Upland Canal
 80. Upper Main Canal
 151. Victoria Canal
 93. Walker Slough
 75. Walthall Slough
 129. Washington Cut
 141. Werner Dredger Cut
 153. West Canal
 122. Whiskey Slough
- 153. West Canal122. Whiskey Slough109. White Slough9. Winchester Lake149. Woodward Canal28. Wright Cut

B SUMMARY OF FISH MERCURY DATA USED IN TMDL NUMERIC TARGET AND LINKAGE ANALYSIS CALCULATIONS

Section B.1 summarizes the fish mercury data used in the numeric target and linkage analysis chapters. Table B.1 lists the fish species and lengths of fish included in the weighted-average¹ fish mercury concentrations. Tables B.2 through B.5 list the number of samples and fish included in the calculations for each Delta subregion. Data for fish sampled in the Cosumnes River and Mokelumne River and in the northern portion of the Yolo Bypass were included in the numeric target development calculations. However, only data for fish sampled in the Mokelumne River downstream of the Cosumnes River confluence were included in the linkage analysis calculations; these data are summarized in Tables B.4 and B.5. All fish data summarized in these tables are provided in Appendix L. Section B.3 provides figures that illustrate the range of mercury levels in the species within each Delta subregion trophic level food group. Appendix C provides a description of the available mercury data for important commercial and sport fisheries – such as striped bass, salmon, crayfish, clams and blackfish – not included in this data summary because they either do not represent local conditions or do not fit within the trophic level food groups defined by the numeric targets.

Weighted average mercury concentration is based on the number of fish in the composite samples analyzed, rather than the number of samples.

B.1 Description of Fish Mercury DATA Used in the Numeric Target and Linkage Analysis Chapters

Table B.1: Summary of Fish Species & Lengths Used in the Numeric Target & Linkage Analysis Chapters

Trophic Level 4 Species & Length Ranges Used for Estimation of Human & Bald Eagle Health Risk

[150-500 mm, unless CDFG minimum catch limit

applies] (a,b)

Black crappie (> 150 mm) Channel catfish (> 200 mm) (b) Largemouth bass (> 305 mm) (a) Sacramento pikeminnow (> 150 mm) (b) Smallmouth bass (> 305 mm) (a)

White catfish (> 200 mm) (b) White crappie (> 150 mm) (b)

Trophic Level 4 Species & Length Ranges Used for Estimation of Otter and Osprey Health Risk (c)

Black crappie (150 - 350 mm)
Channel catfish (200 - 350 mm)
Largemouth bass (150 - 350 mm)
Sacramento pikeminnow (150 - 350 mm)
Smallmouth bass (150 - 350 mm)
White catfish (200 - 350 mm)
White crappie (150 - 350 mm)

Trophic Level 3 Species & Length Ranges Used for Estimation of Human Health and Bald Eagle Risk

[150-500 mm] (d)

Black bullhead Bluegill

Carp

Channel catfish (150 - 200 mm)

Golden shiner Goldfish (e) Redear sunfish Sacramento blackfish Sacramento splittail

Sucker Unid goby

White catfish (150 - 200 mm)

Yellowfin goby

Trophic Level 3 Species & Length Ranges for Estimation of Osprey, Grebe and Merganser Health Risk. [All TL3 fish species, 150-350 mm. Small

individuals of TL4 species of catfish are included.] (c)

Black bullhead Bluegill Carp

Channel catfish (150 - 200 mm)

Golden shiner Goldfish Redear sunfish Sacramento blackfish Sacramento splittail

Sucker Threadfin Shad Unid goby

White catfish (150 - 200 mm)

Yellowfin goby

Trophic Level 3 Species & Length Ranges for Estimation of Cormorant, Otter, Mink and Kingfisher

Health Risk. [All TL3 fish species, 50-150 mm. Small individuals of TL4 species of bass, crappie, and catfish, are included.] (f)

Bigscale logperch

Bluegill

Channel catfish (50 - 150 mm)

Golden shiner Inland silverside

Largemouth bass (50 - 100 mm)

Mosquitofish Prickly sculpin Red shiner Redear sunfish Shimofuri goby Threadfin Shad

Unid goby White catfish (50 - 150 mm) White crappie (50 - 120 mm)

Yellowfin goby

Trophic Level 3 for Estimation of Least Tern Health Risk. [All TL3 and juveniles of TL4 fish species less

than 50 mm.] (g)

Bluegill
Inland silverside
Mosquitofish
Prickly sculpin
Red shiner
Shimofuri goby
White catfish
White crappie

TABLE B.1 FOOTNOTES:

- (a) Size minimum based on CDFG fishing regulations: 12 inch minimum (305 mm) for largemouth and smallmouth bass.
- (b) Size minimum based on prey type of the fish species. Example: on average, catfish 200 mm and larger are mainly piscivorous, meaning that a majority of their diet is trophic level three species. Catfish smaller than 200 mm eat mainly prey from trophic level 2. Minimum sizes based on length of fish when they become mostly piscivorous are given for bass, catfish, pikeminnow and crappie (Source: Moyle PB, 2002. Inland Fishes of California, Revised and Expanded, Berkeley, Univ. California Press)
- (c) Size minimum based on prey type of the fish species see note (b). Maximum size of 350 mm is based on largest size generally consumed by osprey or otter. (For bald eagle, use average concentration in TL4 fish grouped for humans to assess risk).
- (d) TL3 species for calculating human health risk are those species assumed to be eaten by humans, based on general knowledge of the fishery and size of fish. Staff assumes that most fish eaten are at least 150 mm (6 inches). Small bass are not included in the trophic level 3 species for human consumption because they cannot legally be fished and kept. Crappies are not included because juvenile crappies (TL3) are generally less than 120 mm.
- (e) Although goldfish is a TL2 species, large ones may be consumed by humans and are included to estimate human risk. Only one Delta goldfish was analyzed for mercury.
- (f) Fish length range of 50-150 mm based on the size of fish typically consumed by kingfisher, cormorant and mink (USFWS, 2004).
- (g) Size maximum of 50 mm based on general size limit of prey consumed by California least terns (USFWS, 2003).

Table B.2: Number of Composite Samples and the Total Number of Fish in the Composite Samples Used to Estimate the Weighted Average Trophic Level 3 and 4 Fish Mercury Concentrations for Human and Eagle Health Risk Assessments (a)

	Central	Delta	Cosum Rive		Mokelumne Cosumne		Sacrame Rive		San Joa Rive		West D	elta	Yolo Byp Norti		Yolo Byp Sout			
Trophic Level (Length Range) / Species	# of Samples	# of Fish	# of Samples	# of Fish	# of Samples	# of Fish	# of Samples	# of Fish	# of Samples	# of Fish	# of Samples	# of Fish	# of Samples	# of Fish	# of Samples	# of Fish	Total # of Samples	Total # of Fish
TL4 (150-350 mm)	144	218	16	20	15	21	103	166	95	179	31	39	3	11	52	75	459	729
Channel Catfish	1	4							3	14					1	2	5	20
Crappie	2	9									1	3	2	10	1	5	6	27
Largemouth Bass	102	146	14	18	14	18	52	73	60	92	29	33	1	1	15	24	287	405
Sacramento Pike Minnow					1	3	15	33	1	3	1	3					18	42
Smallmouth Bass							1	5									1	5
White Catfish	39	59	2	2			35	55	31	70					35	44	142	230
TL3 (150-350 mm)	17	80	4	12	5	17	11	47	12	47	2	9	2	10	5	23	58	245
Black Bullhead	2	9					2	10									4	19
Bluegill	6	30			2	10	5	20	4	19							17	79
Carp													2	10	4	18	6	28
Redear Sunfish	9	41	1	5					4	20	1	5					15	71
Sacramento Blackfish									1	5							1	5
Sacramento Splittail							1	4									1	4
Sacramento Sucker			3	7	3	7	3	13			1	4			1	5	11	36
White Catfish									3	3							3	3
TOTAL	161	298	20	32	20	38	114	213	107	226	33	48	5	21	57	98	517	974

⁽a) Cosumnes River and Yolo Bypass-North fish data were used in the Delta-wide numeric target evaluation (Chapter 3) but not in the linkage analysis because aqueous methylmercury samples were not collected in these subregions. Marsh Creek fish samples collected upstream of any tidal influence, although within the statutory Delta boundary, were not used in any Delta TMDL evaluations because a separate TMDL effort will be conducted for the Marsh Creek watershed. No fish data that met the data use rules described in Section 4.3.1 were available for the Mokelumne River upstream of the Cosumnes River confluence.

Table B.3: Number of Composite Samples and the Total Number of Fish in the Composite Samples Used to Estimate the Weighted Average Trophic Level 3 and 4 Fish Mercury Concentrations for Wildlife Health Risk Assessments (a)

Trophic Level	Central	Delta	Cosumi Rivei		Mokelumne Cosumne		Sacrame Rive		San Joa Rive		West D	elta	Yolo Byp North		Yolo Byp Sout			
(Length Range) / Species	# of Samples	# of Fish	# of Samples	# of Fish	# of Samples	# of Fish	# of Samples	# of Fish	# of Samples	# of Fish	# of Samples	# of Fish	# of Samples	# of Fish	# of Samples	# of Fish	Total # of Samples	
TL4 (150-350 mm)	100	143	17	17	12	18	78	122	59	117	13	17	2	10	43	56	324	500
Crappie	2	9									1	3	2	10	1	5	6	27
Largemouth Bass	67	83	16	16	11	15	35	47	31	48	11	11			8	8	179	228
Sacramento Pike Minnow					1	3	7	15	1	3	1	3					10	24
Smallmouth Bass							1	5									1	5
White Catfish	31	51	1	1			35	55	27	66					34	43	128	216
TL3 (150-350 mm)	23	82	2	6	3	11	9	32	10	37	1	5					48	173
Black Bullhead	2	9					2	10									4	19
Bluegill	5	25			1	5	5	20	3	14							14	64
Golden Shiner	1	1															1	1
Redear Sunfish	11	43	1	5					3	15	1	5					16	68
Sacramento Blackfish									1	5							1	5
Sacramento Sucker			1	1	2	6											3	7
Threadfin Shad	3	3								ĺ							3	3
Unid Goby							2	2									2	2
White Catfish									3	3							3	3
Yellowfin Goby	1	1															1	1
TL3 (50-150 mm)	193	1391	45	320	9	71	134	711	47	456	66	281			168	833	662	4063
Bigscale Logperch			1	12			10	30	1	2	1	3			27	122	40	169
Bluegill	23	74	10	18	1	5	4	16	6	68	3	13			1	3	48	197
Golden Shiner	24	210					3	45	5	31							32	286
Largemouth Bass	24	133			1	2	8	81	7	60	5	15					45	291
Mosquitofish															1	1	1	1
Prickly Sculpin	1	1													5	8	6	9
Red Shiner							1	1	2	4					1	4	4	9
Redear Sunfish	8	8							1	5							9	13
Shimofuri Goby							3	6			1	1			15	53	19	60

Table B.3: Number of Composite Samples and the Total Number of Fish in the Composite Samples Used to Estimate the Weighted Average Trophic Level 3 and 4 Fish Mercury Concentrations for Wildlife Health Risk Assessments (a)

Trophic Level	Central	Central Delta Cosumnes River			Mokelumne R. d/s Cosumnes R.		Sacramento River		San Joaquin River		West Delta		Yolo Bypass- North		Yolo Bypass- South			
(Length Range) / Species	# of Samples	# of Fish	# of Samples	# of Fish	# of Samples	# of Fish	# of Samples	# of Fish	# of Samples	# of Fish	# of Samples	# of Fish	# of Samples	# of Fish	# of Samples	# of Fish	Total # of Samples	
Silverside	86	801	32	282	6	62	80	424	18	235	45	189			80	498	347	2491
Threadfin Shad	20	147					12	70	5	45	1	5			16	49	54	316
Unid Goby							3	3									3	3
White Catfish							6	15									6	15
White Crappie	3	11	1	1			1	1	1	3	1	2			6	17	13	35
Yellowfin Goby	4	6	1	7	1	2	3	19	1	3	9	53			16	78	35	168
TL3 (<50 mm)	37	201	14	222	2	9	24	124	26	384	22	88			62	296	187	1324
Bluegill	17	136	8	78			8	90	11	276	2	6					46	586
Mosquitofish	4	17	6	144	2	9	2	7	2	13	5	34			11	81	32	305
Prickly Sculpin	1	1															1	1
Red Shiner									11	75					5	27	16	102
Shimofuri Goby							1	3			1	1			3	11	5	15
Silverside	14	43					11	19	2	20	13	37			29	75	69	194
Threadfin Shad	1	4									1	10			13	99	15	113
White Catfish							1	2									1	2
White Crappie							1	3							1	3	2	6
TOTAL	353	1817	78	565	26	109	245	989	142	994	102	391	2	10	273	1185	1221	6060

⁽a) Cosumnes River and Yolo Bypass-North fish data were used in the Delta-wide numeric target evaluation (Chapter 3) but not in the linkage analysis because aqueous methylmercury samples were not collected in these subregions. Marsh Creek fish samples collected upstream of any tidal influence, although within the statutory Delta boundary, were not used in any Delta TMDL evaluations because a separate TMDL effort will be conducted for the Marsh Creek watershed. No fish data that met the data use rules described in Section 4.3.1 were available for the Mokelumne River upstream of the Cosumnes River confluence.

B.2 Range of Mercury Levels in Species Present in Each Delta Subregion

This section provides graphs that show the range of mercury levels in Delta species by trophic level, species, and Delta subregion evaluated in the numeric target and linkage analyses:

- Figure B.1: TL4 Food Group (150-500 mm) Mercury Levels
- Figure B.2: TL3 Food Group (150-500 mm) Mercury Levels
- Figure B.3: TL4 Food Group (150-350 mm) Mercury Levels
- Figure B.4: TL3 Food Group (150-350 mm) Mercury Levels
- Figure B.5: TL3 Food Group (50-150 mm) Mercury Levels
- Figure B.6: TL3 Food Group (<50 mm) Mercury Levels

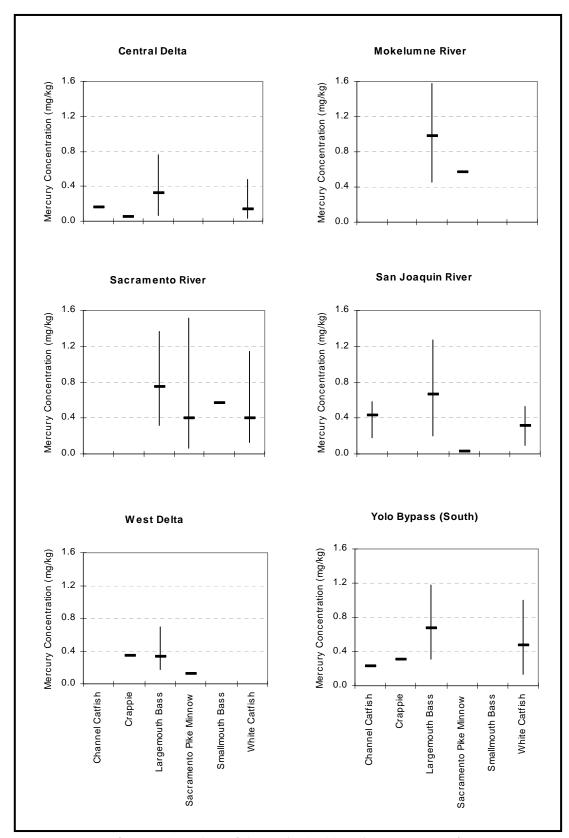


Figure B.1: TL4 Food Group (150-500 mm) Mercury Levels

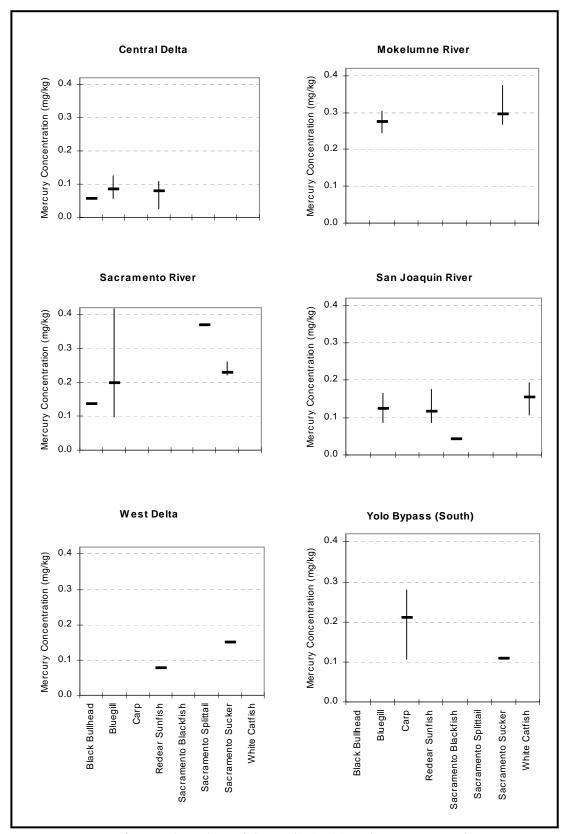


Figure B.2: TL3 Food Group (150-500 mm) Mercury Levels

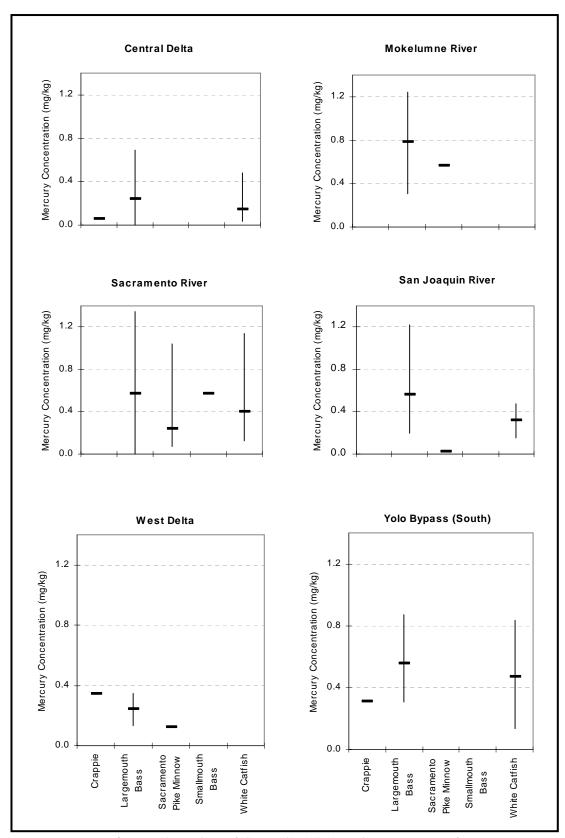


Figure B.3: TL4 Food Group (150-350 mm) Mercury Levels

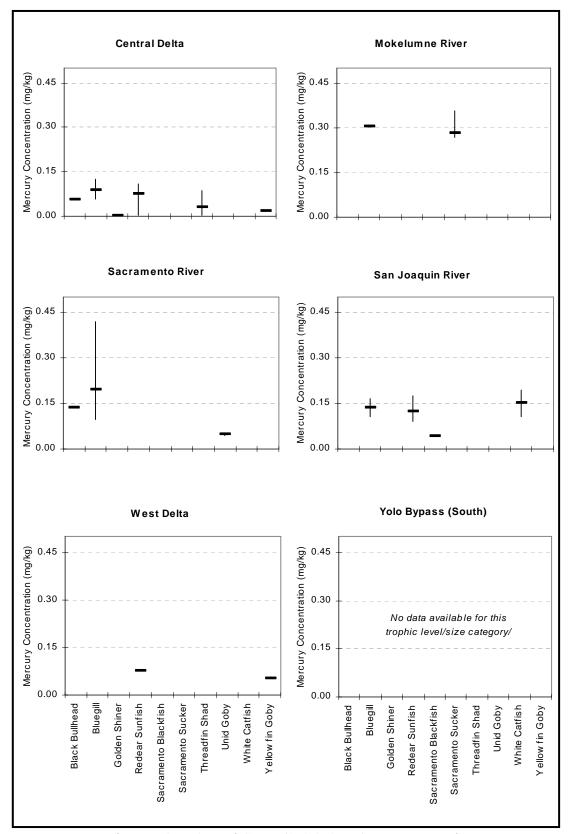


Figure B.4: TL3 Food Group (150-350 mm) Mercury Levels

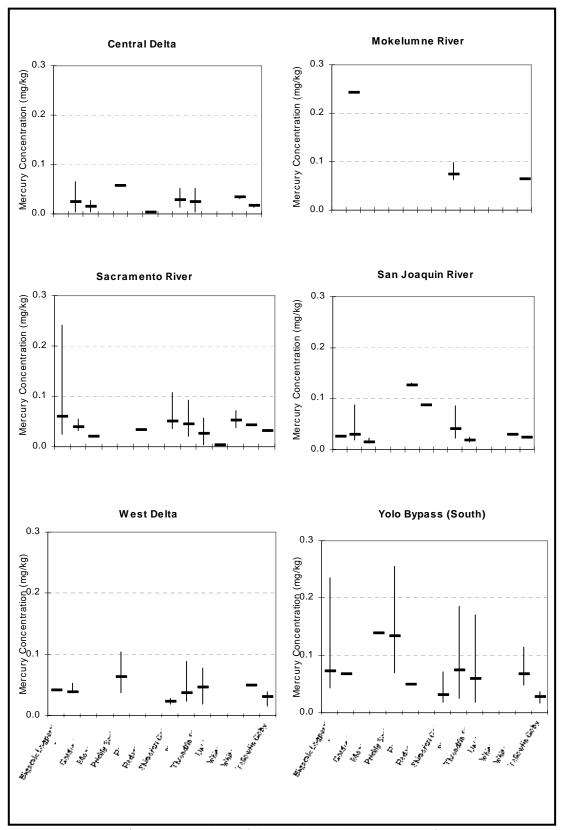


Figure B.5: TL3 Food Group (50-150) Mercury Levels

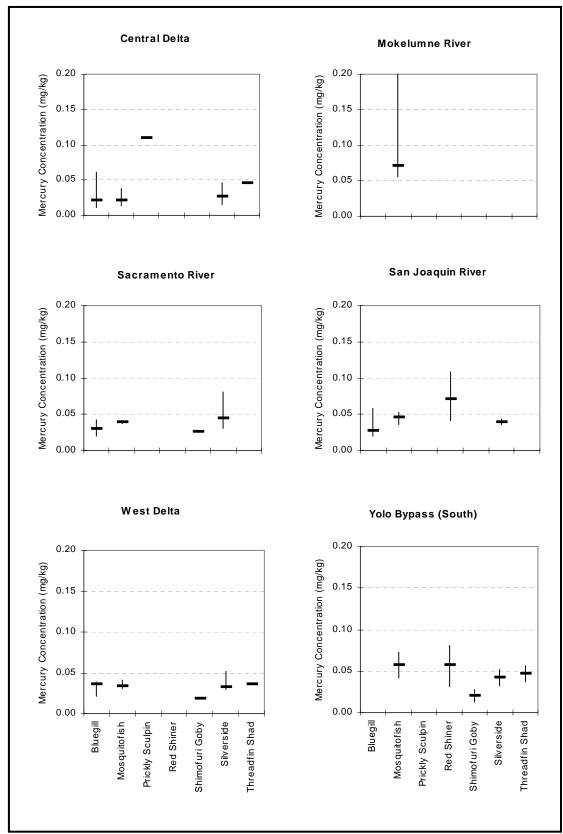


Figure B.6: TL3 Food Group (<50 mm) Mercury Levels

C COMMERCIAL AND SPORT FISHING IN THE SACRAMENTO-SAN JOAQUIN DELTA

As noted in Chapter 2, the Basin Plan lists the existing and potential uses of the Delta. The Basin Plan provides a standard definition for commercial and sport fishing (COMM). The COMM designation is defined as "uses of water for commercial or recreational collection of fish, shellfish, or other organisms including, but not limited to, uses involving organisms intended for human consumption or bait purposes" (CVRWQCB, 1998). The current Basin Plan does not include the commercial and sport fishing (COMM) designation for the Sacramento-San Joaquin Delta. However, commercial and sport fishing is a past and present use of the Delta. The Delta provides habitat for as many as forty freshwater, saltwater and anadromous fishes (Moyle, 2002). Several sport fishes reside in the Delta, including striped bass, black bass (e.g., largemouth and smallmouth bass), sturgeon, Chinook salmon, American shad, and catfish.

Fish and other aquatic organisms also are collected commercially. CDFG issues commercial fishing licenses in California and reports active commercial fishing in the Delta. Bulk historic commercial fishing data were not available; CDFG's Marine Resources website provides summary data for commercial landings and associated values for fishing years 2001 and 2002 (Table C.1). The predominant species targeted include bay shrimp, crayfish and threadfin shad. Threadfin shad are used mainly as baitfish for catching striped bass.

Sport and subsistence fishing is common throughout the Delta and takes place year round. On average, sport fishing license sales in the six Delta counties account for 19% of all licenses issued in the State (Table C.2). It is unknown what portion of those licenses was purchased for fishing within the statutory Delta boundary. However, creel surveys and interviews indicate that sport and subsistence anglers actively fish the Delta waterways year-round by boat and from banks. CDFG's creel surveys indicate that a variety of species are caught and kept (Table C.3, Figure C.1). CDHS Environmental Health Investigations Branch staff conducted interviews of selected groups in the Delta region and found that members of several communities regularly eat local fish, especially striped bass and catfish (CDHS, 2004). Several fishing derbies for striped bass, black bass and sturgeon take place in the Delta every year. In addition to the species listed in Tables C.2 and C.3, Sacramento blackfish, shimofuri goby and clams may also be collected from the Delta (Moyle, 2002; anecdotal information). However, the CDFG creel surveys (CDFG, 2000-2001) and anecdotal information provided by CDFG staff (T. Schroyer, CDFG, personal communication to J. Cooke) indicate that many Delta anglers target salmon, sunfish, striped bass, largemouth bass and catfish and are unlikely to take home clams and shrimp species.

Mercury data from Delta sampling efforts (Table C.4) are available for all of the species listed in Tables C.1 and C.3 (or for similar species) except hitch, longjaw mudsucker, rainbow and steelhead trout, starry flounder, American shad and salmon. Except for American shad and salmon, these species do not appear to be key commercial and sport fish in the Delta. To evaluate American shad and salmon mercury levels for impairment, data from additional Suisun Bay, San Francisco Bay and Delta tributary locations were reviewed. Because salmon are anadromous and spend the majority of their lives in the Pacific Ocean, salmon that are caught in the Delta will most likely have mercury levels similar to those caught upstream in the tributary watersheds. The same is likely true for American shad. Table C.4 includes mercury data for American shad and Chinook salmon collected in the Delta and its upstream tributaries.

Per CDFG fishing regulations, some Delta fish species have size limits:

- Black bass (e.g., largemouth and smallmouth bass) minimum 12 inches (305 mm);
- Striped bass minimum 18 inches (457 mm); and
- Sturgeon between 46 and 72 inches (1,168 to 1,829 mm)

Only samples collected from the tissue (fillet) of fish that met the size limits for these species were included in Table C.4. For other sport fish, only tissue samples collected from fish greater than 100 mm were included. Both fillet and whole fish samples were included for all sizes of threadfin shad, which is used as bait. In addition, all sizes of crayfish and clams were included. Data summarized in Table C.4 were collected between 1970 and 2003.

The Delta-wide weighted average mercury levels in each species were compared to the USEPA criterion for the protection of human health of 0.3 mg/kg and the FDA action level for commercially caught fish of 1.0 mg/kg (Figure C.2). Although many individual samples had mercury levels that exceeded the FDA action level, none of species-specific weighted average mercury concentrations exceeded the action level. In addition, none of the species for which commercial fishing licenses were issued exceeded the USEPA criterion. However, the average mercury concentrations of several sport fish – sturgeon, catfish, crappie, Sacramento splittail, Sacramento pike minnow, largemouth bass, small bass, and striped bass – approached or exceeded the USEPA criterion. The bass had the highest average mercury concentrations of any species. Largemouth bass had mercury levels comparable to striped bass mercury levels.

The linkage analyses described in Chapter 5 and fish data described in Appendix B are based on samples collected between 1998 and 2001 for species that represent local conditions and fit within the trophic level food groups defined by the numeric targets (Chapter 4). All of the species listed in Table C.4 and Figure C.1 were addressed by the numeric target development and linkage analysis (Chapters 4 and 5, Appendix B), except American shad, Asiatic and resident freshwater clams, chinook salmon, Crangon shrimp, crayfish, striped bass and sturgeon. Of these, only striped bass and sturgeon had average mercury concentrations that exceeded the USEPA criterion of 0.3 mg/kg. As methyl and total mercury reduction efforts take place and the numeric targets are approached throughout the Delta for the species described in Appendix B, striped bass and sturgeon data also will be re-evaluated for compliance with the USEPA criterion and other adopted, Delta-specific water quality objectives.

Table C.1: Commercial Fisheries Landings in the Sacramento-San Joaquin Delta and Associated Value (a)

	Landings	s (pounds)	Value				
Species	2001	2002	2001	2002			
Bay shrimp	9,509	9,744	\$56,954	\$63,149			
Carp	214		\$253				
Crayfish	100,008	108,427	\$120,403	\$114,712			
Hitch	20		\$20				
Longjaw mudsucker	29		\$0				
Threadfin shad	53,936	49,343	\$37,258	\$55,028			
Yellowfin goby	285		\$24				
TOTAL:	164,001	167,514	\$214,912	\$232,889			

(a) Source: http://www.dfg.ca.gov/mrd/fishing.html#commercial

Table C.2: Average Number of Sport Fishing Licenses Issued in Six Delta Counties (a,b)

County	Resident Fish Licenses	Striped Bass Tag	Salmon Tag	Steelhead Tag
Alameda	46,240	21,768	429	897
Contra Costa	42,230	26,948	380	1,039
Sacramento	89,617	43,260	1,231	6,306
San Joaquin	43,230	27,906	158	668
Solano	24,338	19,473	161	469
Yolo	9,694	4,567	70	293
Total for Delta Counties:	255,349	143,923	2,427	9,672
Total for California:	1,356,694	342,638	29,293	56,864
% Delta Licences:	19%	42%	8%	17%

⁽a) Source: http://www.dfg.ca.gov/licensing/statistics/statistics.html

Table C.3: Sum of Fish Kept by Delta Anglers per the CDFG's Central Valley Angler Surveys for 1999 and 2000. (a)

Species [Acronym Used in Figure C.1]	Trophic Level	# of Fish Kept
Catfish [CF]	4	4307
Striped Bass [SB]	4	2496
Chinook Salmon [a.k.a. king salmon, KS]	3	812
American Shad [AS]	3	549
Splittail [SPT]	3	439
Sunfish [SF]	3	344
Black Bass [BB]	4	154
Sturgeon [ST]	3	94
Starry Flounder [STF]	3	27
Sacramento Pikeminnow [SPM]	4	22
Common Carp [CP]	3	20
Steelhead Trout [SH]	3	7
Sacramento Sucker [SKR]	3	6
Rainbow trout [RT]	3	1

⁽a) Data obtained from Fraser Shilling (University of California, Davis), who requested the query of actual reported number of fish kept and released by species and river mile from the CDFG Creel Database for the 1999 and 2000 Central Valley Angler Surveys 1999 and 2000. A summary of fish kept by Delta subregion is shown in Figure C.1.

⁽b) Resident fish licenses and salmon tags are averaged over a 10-year period, striped bass averaged over 7 years, and steelhead averaged over 8 years.

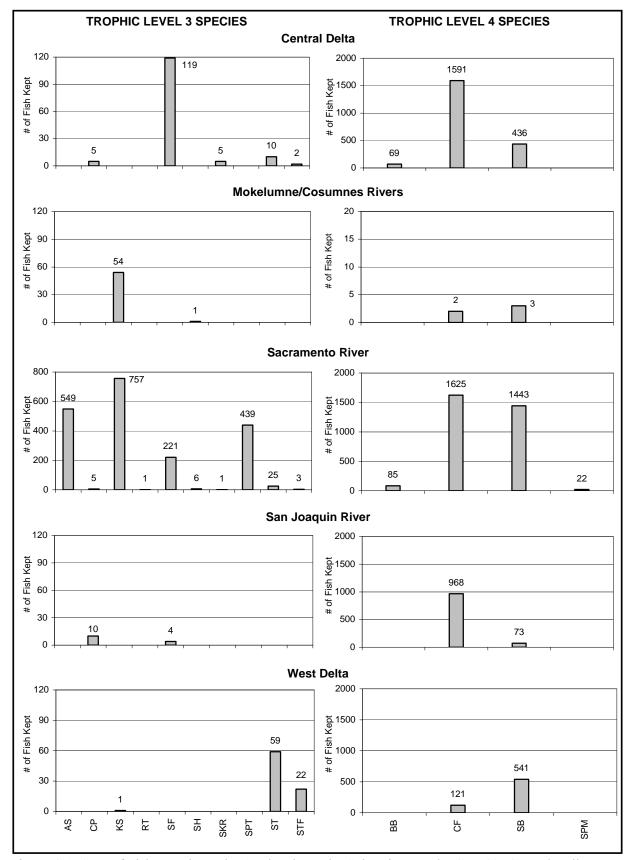


Figure C.1: Sum of Fish Kept by Delta Anglers by Delta Subregion per the CDFG's Central Valley Angler Surveys for 1999 and 2000. (Species acronyms are defined in Table C.3.)

Table C.4: Summary of Available Mercury Concentration Data for Species Targeted by Sport and Commercial Fishing (a,b,c)

Common	# of Samples	# of Fish	Min Hg Conc. (mg/kg)	Ave Hg Conc. (mg/kg)	Max Hg Conc. (mg/kg)	Weighted Ave (mg/kg)
American Shad	5	18	0.030	0.047	0.066	0.048
Black Bullhead	4	19	0.053	0.097	0.138	0.099
Black Crappie	1	6	0.130	0.130	0.130	0.130
Bluegill	31	135	0.028	0.147	0.418	0.129
Carp	13	59	0.107	0.235	0.340	0.234
Catfish	28	28	0.060	0.249	1.180	0.249
Channel Catfish	28	82	0.060	0.235	0.600	0.291
Chinook Salmon	10	15	0.040	0.072	0.120	0.062
Clam, Asiatic	275	717	0.007	0.042	0.195	0.039
Clam, Resident Freshwater	3	3	0.016	0.035	0.050	0.035
Crangon Shrimp	10	72	0.006	0.008	0.010	0.008
Crappie	6	27	0.054	0.296	0.591	0.301
Crayfish	383	413	0.003	0.191	1.828	0.182
Largemouth Bass	298	433	0.062	0.585	2.090	0.561
Redear Sunfish	17	88	0.027	0.106	0.329	0.106
Sacramento Blackfish	1	5	0.043	0.043	0.043	0.043
Sacramento Pike Minnow	26	55	0.028	0.572	2.400	0.429
Sacramento Splittail	1	4	0.370	0.370	0.370	0.370
Sacramento Sucker	12	43	0.100	0.271	0.492	0.234
Shimofuri Goby	24	75	0.013	0.034	0.107	0.031
Smallmouth Bass	1	5	0.570	0.570	0.570	0.570
Striped Bass	201	245	0.060	0.572	1.850	0.571
Sturgeon	11	11	0.080	0.271	0.800	0.271
Threadfin Shad	72	432	0.003	0.038	0.171	0.034
White Catfish	190	425	0.031	0.343	1.270	0.365
Yellowfin Goby	2	33	0.040	0.050	0.060	0.048

⁽a) CDFG's legal limit is 12 inch minimum (305 mm) for largemouth and smallmouth bass, 18 inch minimum (457 mm) for striped bass, and between 46 and 72 inches (1,168 to 1,829 mm) for sturgeon; only data collected from tissue (fillet) samples were included. For other sport fish, only tissue samples collected from fish greater than 100 mm were included. Both fillet and whole fish samples were included for all sizes of threadfin shad, which is typically used as bait. In addition, all sizes of crayfish and clams were included. Results represent total mercury, wet weight concentrations.

⁽b) Little-to-no mercury data were available for adult salmon and American shad caught in the Delta. To evaluate salmon mercury levels for impairment, data from Suisun Bay and Delta's tributary watersheds were reviewed. Because salmon are anadromous (they spend the majority of their lives in the Pacific Ocean and return to fresh waters only to spawn) adult salmon (typically >750 mm) that are caught in the Delta most likely have mercury levels similar to those caught elsewhere in the Bay-Delta and tributary watersheds. The same is likely true for American shad. American shad samples were collected from the American River, Sacramento River downstream of the Feather River confluence, and Suisun Bay. Chinook salmon samples were collected from the upper Sacramento River near Red Bluff, American River, Sacramento River at River Mile 44 and San Francisco Bay.

⁽c) Data summarized in this table were collected between 1970 and 2003. In contrast, the numeric target development and linkage analyses are based on data collected between 1998 and 2001.

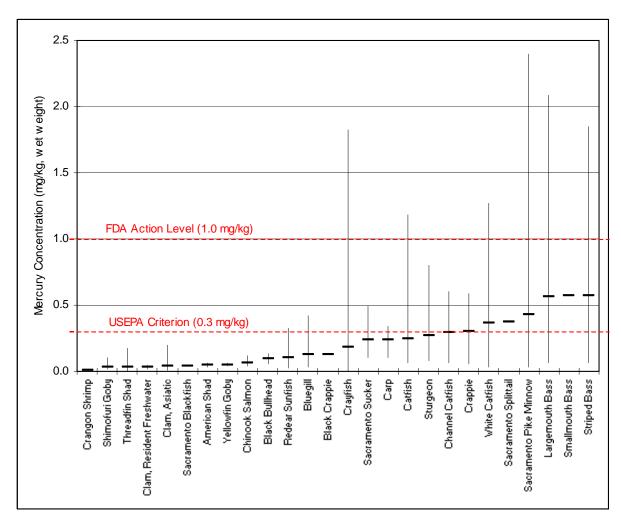


Figure C.2: Minimum, Maximum and Weighted Average Mercury Concentrations in Species Targeted by Sport and Commercial Fishing Based on Available Data